PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

EP. 16078

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 3 : B41M 1/12; B41L 13/02; B41F 15/04	A1	(11) International Publication Number: WO 80/00145 (43) Internati nal Publication Date: 7 February 1980 (07.02.80)

(21) International Application Number: PCT/US79/00442
(22) International Filing Date: 20 June 1979 (20.06.79)
(31) Priority Application Number: 919,862
(32) Priority Date: 28 June 1978 (28.06.78)
(33) Priority Country: US

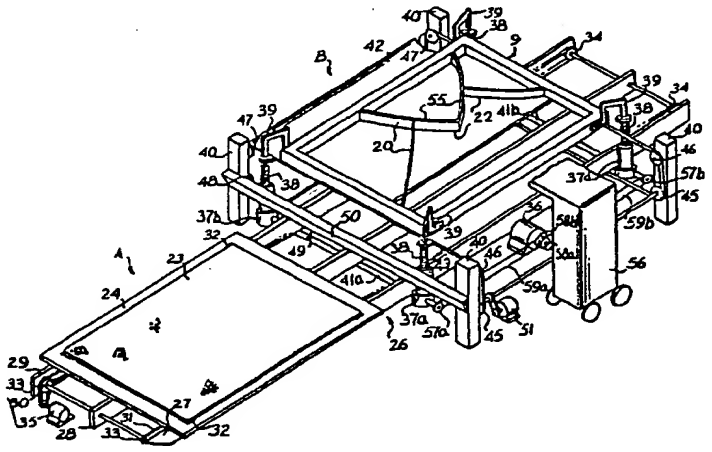
(71) Applicant: and
(72) Inventor: VIDALIS, Ted [CA/US]; 2108 Club Drive, Suite No. 1 Dalton, GA 30720 (US).

(74) Ag nt: MIDDLETON, James, B.; P. O. Box P, Decatur, GA 30031 (US).

(81) Designated States: CH (European patent), DE (European patent), FR (European patent), GB (European patent), JP, SU.

Published with:
International search report

(54) Title: RUG STENCIL PRINTING SYSTEM



(57) Abstract

Process for printing pile fabrics, and apparatus for carrying out the process. A stencil (9) having divider walls (20) to define the various pattern areas (21) is urged against the pile fabric (23) so that the divider walls (20) penetrate the pile (25) and engage the base (52) of the fabric to maintain separation of different colors or the like in the different pattern areas. A spray apparatus (53) is then used to spray the pattern areas, the outlet (54) of the spray apparatus (53) being held at all times within the confines of the divider walls (20). After spraying, the stencil (9) is lifted and a canopy (42) is placed between the stencil (9) and the fabric (23). The stencil (9) comprises a frame (10) with wires (19) extending across the frame (10) in two directions for carrying the divider walls (20). Mechanical means (37) are provided to raise and low r the stencil (9), and a fly-bridge (56) is movable above the stencil (9) for access to all pattern areas (21).

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT

AT	Austria	**LU**	Luxembourg
BR	Brazil	**MC**	Monaco
CF	Central African Republic	**MG**	Madagascar
CG	Congo	**MW**	Malawi
CH	Switzerland	**NL**	Netherlands
CM	Cameroon	**RO**	Romania
DE	Germany, Federal Republic of	**SE**	Sweden
DK	Denmark	**SN**	Senegal
FR	France	**SU**	Soviet Union
GA	Gabon	**TD**	Chad
GB	United Kingdom	**TG**	Togo
JP	Japan	**US**	United States of America

RUG STENCIL PRINTING SYSTEM

Field of the Invention

This invention relates to the printing of pile fabrics, and is more particularly concerned with a stencil for multi-color printing of pile fabrics and a method and apparatus utilizing said stencil.

Background of the Invention

Multi-color patterned area rugs, wall rugs and other pile face materials have met with increasing commercial success in the United States in the past few years. Traditionally such products are associated with various weaving processes using pre-dyed yarns. Generally, skilled operators are required for these processes, productivity is low, and the products are expensive. In the tufting industry products of this kind are currently manufactured by means of the manually operated tufting gun; and, in recent times, such products are made by single and double needle control broadloom tufting machines. With single needle machines, although productivity is low and the products are expensive, a few companies have been able to make a commercial success of the operation. With double needle machines productivity is high; but, in relation to the investment, the productivity traditionally associated with broadloom tufting is low. Even so, in the context of area rugs, these machines are capable of producing a limited variety of styles at rates exceeding the capacity of the market for them. For these reasons these machines have not realized the future predicted for them.

Within the past fifteen years or so a very large carpet printing industry has grown up within the tufting industry. The carpet printing industry is geared largely to broadloom manufacture and is not especially suitable for the pattern flexibility, variety of carpet textures and pattern sizes traditionally associated with high quality area rugs. Moreover, the capital investment required for these printing machines can be generated only by the enormous productivity of the broadloom industry.

There are numerous methods used for dye printing piled sheet materials, such as carpets, towels, animal furs and the like. These printing methods include flat screen printing, rotary screen printing, raised pattern roller printing, "deep dye" printing, and the Militron process.

The flat screen methods involve the use of screens which contact the surface of the sheet material. The dye pastes are applied to the top surfaces of the screens and forced through holes in the screens by magnetic squeegies, sponges, or by suction from behind the sheet material. The screens are impenetrable in some areas and penetrable in the pattern areas where it is desired that dye pass to the sheet material.

The rotary screen is an adaptation of the flat screen wherein the screen is formed in the shape of a cylinder. Roller processes involve the use of cylinders with patterned dye areas raised from the surface of the cylinder. The cylinders pick up dye on the faces of the raised dye areas and transfer the dye to the sheet material according to the pattern of the dye area by rolling over the sheet material as the material moves along its length through the machinery.

The screen and roller processes are capable of printing low pile materials such as materials having pile in a quantity of about 8 to 14 oz. per sq. yd., but they usually lack the ability to produce satisfactory results on heavier, high pile, materials as there is insufficient dye material passing through the screens and insufficient force exerted on the dye material to penetrate heavier weights of pile facing.

In the screen and roller dyeing processes a separate screen or roller is required for each different color. This makes multi-color processes somewhat expensive, both because of duplication and because of mechanization and precision needed to register the separate color patterns. Another disadvantage of these processes is that they are limited in their pattern size, thus requiring several pattern components to form a single large size pattern as might be associated with an area rug.

The "deep dye" process offers a method of applying all the colors of a pattern to the sheet material simultaneously. In this system, the printing stencil comprising partitioning built up on a plate to form trough-like pattern elements into which various colors of dye solution are fed, is pressed mechanically upwardly against the downwardly facing pile of the sheet material. The equipment for performing the deep dye process is expensive to manufacture and to operate.

The Militron process is one uniquely capable of printing broadloom carpeting and area rugs. The process is based on the simultaneous injection of several colors of dye solution from a matrix of fine nozzles. Those nozzles in the matrix which fall within the particular element of the pattern to be printed are controlled so they all pass the same color of dye solution together. The device is computer controlled, and the pattern is readily changed. The machine involves high capital investment and is not generally available. It is also, as far as is known, limited to a comparatively narrow range of carpet pile textures.

Summary of the Invention

The present invention comprises a method of printing sheet materials which alleviates many of the aforementioned difficulties as they apply to area rug printing. The invention also comprises a novel pattern stencil and print substrate handling platform used in the printing method. The process works successfully on both low and high pile face materials. Multi-color printing can be accomplished in one application, without bleeding, by using a single pattern stencil, thus circumventing the need to use a separate stencil for each color application as applied in "silk" screen printing processes. Also, the pattern stencil can be built to the size of the material to be printed, eliminating the registration problems involved in having to use several stencils to build up the pattern.

The pattern stencil of the present invention comprises a plurality of divider walls suspended within a frame. These

walls define the individual color areas of the pattern. The walls of the stencil assembly are suspended in the open space within the frame and are supported by a wire matrix extending from the frame.

Typically area rugs are made in sizes of six by nine feet and nine by twelve feet, and for printing them the pattern stencils of the present invention are made commensurate with these sizes. The printing platform and rack of the present invention would also have to be commensurate in size so that each rug size would require commensurate printing apparatus. A large stencil can be built comprising two or more small rug patterns set side by side, thus permitting printing of two or more small rugs at one time. In printing large area rugs--6' x 9' and larger--the distances across the stencil are too great for the reach of the operators handling the print paste dispensing guns. To overcome this difficulty, and to optimize the conditions of application, a fly-bridge is provided for each printing apparatus. The fly-bridge comprises a motorized platform bridging the stencil and mounted on wheels which run on tracks laid on the floor on both sides of the printing apparatus. Swivel seats, which also can be easily moved on rails transversely along the length of the fly-bridge, are furnished for the operators so they can move freely to any position over the platform. The operators can also drive the fly-bridge back and forth along the length of the stencil and are thus able to position themselves with little effort over any desired portion of the stencil. While seated on the fly-bridge the operators can also control operation of the entire printing apparatus.

In application, the stencil is suspended horizontally by mechanical means by which it can, as needed, be raised and lowered over a printing platform. The platform is rack mounted so that it can be moved transversely along the rack to three basic positions: the loading position, the printing position and the unloading position. In the loading position the platform is fully withdrawn from under the stencil, permitting the unprinted rug to be precisely mounted on

the platform with its pile face up. The accurate fitting of the rug on the platform is achieved by aligning the edges of the rug with the edges of the platform, or with marks on the platform surface. The platform is then moved along the rack to the printing position where the rug is vertically aligned with the stencil. Precise fitting of the rug on the platform during loading is thus the means for properly positioning the rug beneath the stencil for accurately printing the rug. The stencil is lowered on to the rug during printing, and afterwards raised again; and, the platform, now carrying the printed rug, is moved further along the rack to the unloading position where the rug is removed. The empty platform is then returned to the loading position in readiness for another printing cycle. When the platform moves from the loading position to the printing position it passes under a fixed, or rotary, doctor blade which fluffs up the pile face of the rug and removes whatever pile disorientation may have taken place in handling and loading the rug. Also, whenever the stencil is raised, and before the platform can be moved transversely into or out of the printing position, a canopy extends automatically beneath the stencil, between the stencil and the rug on the printing platform to shield the rug from possible print paste drippings from the raised stencil.

The process performed by the printing assembly of the present invention includes the steps of moving the sheet material mounted on a movable platform into the printing zone, lowering the stencil on to the sheet material where the walls of the stencil extend between individual face piles of material and make edge contact with the sheet material backing, thus preventing paste from bleeding between areas of different color and insuring printing of all the face piles by not incurring matting down of fibers under the stencil elements. The print paste is applied to the material by holding a dispensing nozzle in the vicinity of the sheet material below the height of the walls of the stencil and by dispensing the desired color of print paste on to the

piles located in the area between adjacent walls. After printing by the present process has been completed, the stencil is raised from the sheet material and the canopy is immediately moved into position above the platform area between the sheet material and the stencil in order to catch any drippings of excess print paste.

Brief Description of the Drawings

These and other features and advantages of the invention will become apparent from consideration of the following description taken in conjunction with the accompanying drawings in which:

Fig. 1 is a perspective view of a stencil made in accordance with the present invention;

Fig. 2 is a perspective view of one stencil element of the stencil shown in Fig. 1;

Fig. 3 is a perspective view of a stencil similar to Fig. 1 but displaying a different design pattern;

Fig. 4 is a perspective view of the printing apparatus of the printing system of the present invention including the printing platform, stencil and fly-bridge;

Fig. 5 is a detail perspective view showing a stencil wall of the stencil of the present invention positioned on sheet material with a print paste dispenser in position to dye the material; and,

Figs. 6 and 7 are schematic illustrations showing the control circuitry for use with the apparatus shown in Fig. 4.

Best Mode of the Invention

Referring in more detail to the drawings, Fig. 1 shows a stencil assembly which includes a stencil 9 as used in the present invention. The stencil 9 includes a rectangular frame 10 having four sides 13, 14, 15 and 16. The frame 10 encircles an empty space which will be referred to as the pattern space 11. A number of various shaped stencil elements 18 are arranged in the pattern space 11 within the rectangular frame 10 in such a manner as to define, in conjunction with the stencil frame 10 and the pattern space 11, a desired coordinated design pattern.

As illustrated in Fig. 2, each stencil element 18 comprises a plurality of divider walls 20 connected together and defining an encircled space 21. The encircled space 21 is part of the previously mentioned empty pattern space 11. The sections of empty pattern space 11 which are not definable as encircled spaces 21 will be referred to as unencircled pattern space 11. The stencil elements 18 are supported inside the frame 10 by wire elements 19 running between opposed sides 13 and 15 and between opposed sides 14 and 16 of the frame 10. The wire elements 19 are spaced apart and support the stencil elements 18 in their correct positions relative to other stencil elements 18 and to the frame 10. Depending on the intricacy of the design, it may be necessary to put a double row of wire elements 19 in some places, one above the other. If only one row of wires 19 is used, it may be desirable that the wires be located below the center of the divider walls 20 to obtain the best vertical stability.

The wire elements 19 are pulled tight so sagging of the stencil elements 18 within the pattern space 11 will be minimized. The divider walls 20 and stencil elements 18 are maintained in their proper positions in the frame by being fastened to the wires to prevent the stencil elements from moving along the wires. This can be done, for example, by tacking the wire directly to the stencil with solder or the like, or by soldering a knot on the wire on each side of the wall 20. Where two perpendicular wires 19 cross, they can be tacked together.

As is shown in Fig. 3, it is not always necessary that the divider walls 20 be formed into individual stencil elements 18. It is also the teaching of the present invention to interconnect the divider walls 20 with one another and with the sides 13, 14, 15 and 16 of the stencil frame 10. In this way the entire pattern space 11 is divided up into a series of encircled spaces 21. Wire elements 19 are again used to support the walls 20 as they span the pattern space 11.

The lower edges 22 (see Figs. 2, 4 and 5) of the walls 20 are located in a single plane parallel to the plane defined by the stencil frame 10. The divider walls 20 extend perpendicularly to this same plane.

Fig. 4 illustrates the printing apparatus made in accordance with the present invention. The printing apparatus comprises a platform 24 movably mounted on an elongated stationary rack 26 including three parallel rails 27, 28 and 29. A rug 23 is shown on the top surface of the platform 24. The platform 24 has indexing or positioning marks 32 on its top surface and has wheels (not shown) mounted on its underside which run along the upper edges of the rails 27, 28 and 29 of the rack 26. Chains 30 and 31 encircle the rack 26 lengthwise and are connected to the platform 24. At each end of the stationary rack 26 the chains 30 and 31 pass over sprockets 33 and 34. One set of sprockets are driving sprockets 33 operated by an electric platform motor 35.

One end of the rack 26 will be referred to as the platform loading zone A and the opposite end of the rack will be referred to as the platform unloading zone C. The printing zone B of the platform is located toward the unloading zone C. Four mechanically coordinated motorized jacks 37a, 37b, 37c (not shown) and 37d, having screw elements 38, are located in the printing zone B of the apparatus and define a rectangular area slightly wider than the platform 24. Each jack 37 is oriented so that the screw element 38 extends perpendicularly to the platform 24. The four motorized screw jacks 37a, 37b, 37c, 37d are all operated simultaneously by the same jack operating motor 36 so movement of the four jacks will be coordinated. Two jacks, 37a and 37b, are connected by rotatable shaft 41a; and, two jacks, 37c and 37d, are connected by rotatable shaft 41b. The shafts 41a and 41b, when rotated, operate the screw elements 38 of the respective jacks 37. A driven pulley 57a is attached to an extension of the shaft 41a, and a driven pulley 57b is attached to an extension of the shaft 41b. Two drive pulleys 58a and 58b are attached to the shaft of the

jack motor 36, and each set of drive pulleys and driven pulleys 57a and 58a, and 57b and 58b respectively, is connected by a timing belt 59a or 59b surrounding the two pulleys. Through this arrangement, the four jacks are operated in mechanized coordination.

Four canopy stands 40 are positioned about the printing zone B with one stand 40 located near each of the jacks 37. The four canopy stands 40 support a canopy mechanism which comprises a canopy 42 attached to two canopy supporting chains 43 and 44, each of which is carried by, and extends about, four sprockets 45, 46, 47 and 48. The driving sprockets 45 are simultaneously driven by an electric canopy motor 51. The canopy supporting chains 43 and 44 are located to encircle the rack 26 perpendicularly to the rack rails 27, 28 and 29 with the upper portion of the canopy supporting chain higher than the level of the platform 24. To give strength to the canopy 42 and prevent its sagging, rigid tubing (not shown) is extended between, and connected to, the two supporting chains 43 and 44 and attached to the canopy. A doctor blade 49 is mounted across the two canopy stands 40 nearest to the loading zone A and on the side of the canopy stand facing the loading zone. The blade 49 is parallel to the plane of the rug 23 and platform 24, and is adjustable in height along the stands 40 relative to the rug 23. This doctor blade 49 is, in the present embodiment, a steel angle, one flange 50 of which extends downwardly into contact with the fibers 25 of the rug 23.

The printing method proceeds as follows: a stencil 9, having elements as previously described, is assembled to represent the desired design pattern and is made as large or small as necessary to fit the size of the rug 23, or like material, to be printed. A stencil bracket 39 is fastened to each corner of the stencil 9. Each bracket 39 is formed so that it can reach over the canopy supporting chain 43 or 44 and sit on top of the screw element 38 of its respective jack 37. The brackets 39 avoid contact with the chains 43 and 44 even when the jacks 37 are lowered to position the stencil 9 on the platform 24. The stencil 9 is then placed

in position in the printing zone B with each of the four brackets 39 at the corners of the stencil resting on one of the jack screws 38. The screws 38 are fully extended to hold the stencil high above the rack 26. The canopy 42 is in its extended position above the rack 26 and below the stencil 9. The rug 23 (see Fig. 4) is placed on the platform 24 in the loading zone A with carpet pile face 25 facing up from the platform 24. The rug 23 is accurately positioned on the platform 24 by an appropriate indexing system. For example, in the disclosed embodiment the rug 23 is aligned with indexing marks 32 on the platform to insure proper positioning on the platform.

The electric motor 35 is activated and the platform 24 and rug 23 are pulled by chains 30 and 31 from the loading zone A into printing position under the stencil in the printing zone B. The platform 24, with the rug 23 accurately positioned on the platform, is stopped in the printing zone B at a printing position where the rug is in proper vertical alignment with the stencil 9. Since the printing position of the platform 24 is automatically controlled, as later described, and since the stencil 9 moves in a fixed vertical plane, the proper vertical alignment between rug 23 and stencil 9 is achieved by accurately placing the indexing marks 32 on the platform relative to the fixed vertical alignment of the stencil over the platform when the platform is in the printing position, and then aligning each rug on the indexing marks 32 each time a rug is placed on the platform. As the rug 23 enters the printing zone B, the doctor blade 49 engages the face pile 25 with the extending flange 50 and fluffs up the piles as they pass by and makes them stand vertically to facilitate proper positioning of the divider walls 20 between the piles.

Once the platform 24 and rug 23 have been moved into position in the printing zone B, the canopy motor 51 is switched on and the canopy 42 is retracted to its position underneath the rack 26. The stencil 9 is lowered on to the rug 23 so that the walls 20 pass between the individual piles 25 until the lower edges 22 of the divider walls 20

make contact with the rug backing 52 (see Fig. 5). The individual piles 25 are segregated to either one side or the other of the divider wall 20 to create a well defined separation between piles of adjacent encircled areas 21. The great majority of piles 25 will take positions on one side or the other of the divider walls 20, but it is expected that some of the piles 25 may become trapped below the walls 25. The lowering (and subsequent lifting) of the stencil 9 in the disclosed embodiment is accomplished by the retraction (and extension) of the four jacks 37. The four stencil brackets 39 are rigidly connected to the stencil 9, but are not connected to the jack screws 38, so the jacks 37 continue to retract, leaving the stencil resting on the rug 23.

After the stencil 9 has been properly positioned on the rug 23, print paste is applied to the rug pile face 25 according to the color scheme of the design pattern. Each different encircled space 21, and any unencircled pattern space 11, may receive a different color or treating agent, or may be left uncolored. The print paste, in the preferred method, is applied by spray dispensers 53 (see Fig. 5) which are hand held by operators positioned on a movable fly-bridge 56 suspended above the platform area. The nozzle end 54 of the spray dispenser 53 is held below the upper edge 55 of the divider wall 20 and moved about between adjacent divider walls 20. In this way the print paste meant for pile face fibers 25 on one side of a divider wall 20 will not flow over to those on the other side. The term "print paste" of the present invention is meant to be a generally inclusive term encompassing dyes, resists and other treating agents of various colors and viscosities.

When all the print pastes have been applied, the stencil 9 is lifted from the rug 23 and the canopy 42 is immediately moved into place between the carpet and the stencil to catch any drippings which may fall from the stencil 9. The platform 24, now carrying the printed rug 23, is moved further along the rack 26 by the motor 35 and chains 30 and 31 to the unloading zone C. Here the rug 23 is removed from the platform 24, and the platform is returned to the loading

zone A by reversing the directional mode of the motor 35.

The circuitry controlling th movement of the platform 24, canopy 42 and stencil 9 of the present invention is shown in Figs. 6 and 7. Fig. 7 shows the platform motor 35, canopy motor 51, and jack operating motor 36 which will hereinafter be referred to as stencil motor 36 for ease of understanding. As will be obvious to those skilled in the art from inspection of Fig. 7, the motors 35, 51, and 36 in the preferred embodiment are driven by a three-phase 230 volt source indicated by the three lines noted as 79. As may further be seen from Fig. 7, platform motor 35 may be operated in one direction by closing a set of three contacts shown as PMF5, and the other direction by closing a set of contacts PMR5. Likewise, canopy motor 57 may be run in a first direction by contacts CMF5 and in a reverse direction by contacts CMR5. Also stencil motor 36 may be operated in a first direction by contacts SMF5 and in the opposite direction by SMR5.

The control logic circuitry of the present invention is shown in Fig. 6. It is to be noted that the circuitry includes a number of relays whose coils are designated as R1, R2, R3, R4, R5, R6, CMF, CMR, SMF, SMR, PMF, and PMR. The designations for the relay coils shown in Fig. 6 have been selected to aid in understanding their function. Coils R1--R6 activate relays which are internal to the control system shown in Fig. 6. Relay coil PMF corresponds to "platform motor forward" and PMR corresponds to "platform motor reverse". Likewise coils CMF and CMR correspond to coils controlling the forward and reverse movement of the canopy motor 51, respectively, and coils SMF and SMR control the stencil motor 36.

To understand the operation of the control circuitry it must be understood that contacts PMF5 shown in Fig. 7 are closed on excitation of coil PMF shown in Fig. 6. Similarly contacts PMR5 shown in Fig. 7 are closed by the excitation of coil PMR shown in Fig. 6. Likewise contacts CMF5 are closed by excitation of coil CMF; contacts CMR5 are closed

by excitation of coil CMR; contacts SMF5 are closed by excitation of coil SMF; and contacts SMR5 are closed by excitation of coil SMR.

It should be further understood that contacts C1A and C1B are closed by excitation of coil R1 as shown in Fig. 6 and in a similar manner contact C2 is closed by excitation of coil R2. It can therefore be seen that in Fig. 6, contacts denoted as CX, where X is an integer, are closed by excitation of a coil RX, where X is the same integer. Also contacts noted as PMFX are closed by coil PMF; contacts noted as PMRX are closed by excitation of coil PMR; contacts noted as CMFX are operated by excitation of coil CMF; contacts noted as CMRX are operated by excitation of coil CMR; contacts noted as SMFX and SMRX are operated by excitation of coils SMF and SMR respectively.

A control circuit shown in Fig. 6 also includes seven limit switches which are activated by the mechanical movements of the platform 24, canopy 42, and stencil 9. All limit switches with the exception of switch 65 are two-pole-single-throw switches. Switches 60a and 60b are mechanically activated when the platform 24 is in its loading position in the loading zone A. Switches 61a and 61b are mechanically activated when the platform 24 is at its printing position in printing zone B and switches 62a and 62b are mechanically activated when the platform 24 reaches its unloading position in unloading zone C. Similarly switch 65 is operated when the stencil 9 is in its up position and switches 66a and 66b are operated when the stencil is in its down position. Switches 67a and 67b are mechanically activated when the canopy 42 is in its extended position above the rack 26 and switches 68a and 68b are mechanically activated when the canopy is in its retracted position below the rack 26.

The arrangement of the control circuitry shown in Fig. 6 is such that its operation may be conveniently explained by defining three cycles. The first cycle is initiated when the platform 24 is in its loading position with a rug 23 loaded thereon. Therefore switch 60a is closed and

switch 60b is open at the beginning of the first cycle. Depression of start button 75 completes a circuit through lines 80 and excites coil R1. The excitation of coil R1 closes contacts C1 thus completing a circuit between points 81 and 82 which completes a circuit through switches 66a and 60a to line 85, thus exciting coil R2. The excitation of coil R2 closes contact C2 completing a circuit between points 86 and 82. As will be obvious to those of ordinary skill in the art, the closing of contact C2 will latch coil R2 while switch 60a opens in response to the platform's moving from its loading position and contact C1a opens when start switch 75 is released.

The closing of contact C2 also completes a circuit between point 86 and point 87 which provides excitation to coil R3 through switch 61a and line 88. The excitation of coil R3 closes contact C3 and completes a circuit through switch 62a to point 89, along line 90 to line 91, thus exciting coil PMF.

The excitation of coil PMF closes contacts PMF5 (shown in Fig. 7) thus operating platform motor 35 and causing forward movement of the platform 24 from its loading position towards its printing position. Since contact C2 latches coil R2, thus assuring prolonged excitation of coil R3, contact C3 will remain closed and maintain holding current on coil PMF until switch 61a opens causing coil R3 to become deenergized. When the platform reaches its printing position, switches 61a and 61b are mechanically tripped to be opened and closed respectively. The opening of switch 61a deenergizes coil R3, thus opening contact C3 and terminating the energized state of coil PMF. This stops operation of the platform motor 35. The closing of switch 61b completes a circuit from point 87 to line 92 on to point 95 thus exciting coil CMF. The excitation of coil CMF closes contacts CMF5 (shown in Fig. 7) causing canopy motor 36 to become activated and begin retracting the canopy 42. Furthermore, the excitation of coil CMF opens normally closed contacts CMF1 preventing excitation of coil CMR. The system remains in this state until the canopy 42 has been retracted to the

point where it mechanically operates limit switches 68a and 68b. When the canopy reaches its fully retracted position, switches 68a and 68b are opened and closed respectively. The opening of switch 68a opens the circuit between points 92 and 95 and deenergizes coil CMF. The closing of switch 68b completes a circuit between points 92 and 96, energizing coil SMF.

The excitation of coil SMF closes contacts SMF5, (shown in Fig. 7), thus lowering the four jacks 37 and lowering the stencil 9. Also, the excitation of coil SMF opens normally closed contacts SMF1 preventing excitation of coil SMR. When the stencil reaches its printing position, it mechanically opens limit switch 66a and closes limit switch 66b. The opening of switch 66a terminates the connection between line 70 and point 86, deenergizing coil R2, which causes contact C2 to open and maintains coils R2, R3, CMF and SMF in their unexcited states. This completes the first cycle of operation and the control circuit is in a stable state.

Once printing of the rug 23 has been completed, depression of start switch 75 will begin the second cycle of operation of the control circuit. The depression of start switch 75 again energizes coil R1 thus closing all contacts associated therewith. However, limit switch 66a is open, therefore the closure of contacts C1a in response to the excitation of coil R1 will not energize coil R2. However the excitation of coil R1 closes contacts C1c. As may be seen from Fig. 6, the closure of contacts C1c completes a circuit through switch 66b (which is closed due to the down position of the stencil) and switch 62a to line 97 and thus energizes coil R4. The excitation of coil R4 closes contact C4 thus completing a circuit between point 89 and point 98 and thereby latching coil R4. As may be seen from the foregoing, the latching of coil R4 in response to the closure of contact C1c at the beginning of the second cycle of the control circuit is similar to the latching of coil R2 in response to the closure of contacts C1a at the beginning of the first cycle.

Closure of contact C4 also completes a circuit between points 89 and points 99 to line 100 thus exciting coil SMR. The excitation of coil SMR opens normally closed contacts SMR1 preventing excitation of coil SMF and closes contacts SMR5 (shown in Fig. 7) causing stencil motor 36 to begin raising the stencil by the raising of the four jacks 37. The control circuit remains in this state until the stencil 9 reaches its uppermost position and closes limit switch 65. The closure of limit switch 65 completes a circuit along line 101 which excites coil R6. The excitation of coil R6 both closes contacts C6b and opens normally closed contacts C6a. The opening of contacts C6a deenergizes coil SMR and the closure of contacts C6b completes a circuit between point 99 and point 102 through switch 67a which allows excitation of coil CMR. The excitation of coil CMR opens normally closed contacts CMR1 thus preventing excitation of coil CMF and closes contacts CMR5 (shown in Fig. 7), thus causing canopy motor 51 to begin retraction of the canopy 42. The circuitry remains in this state until the canopy reaches its extended position and mechanically opens limit switch 67a and closes limit switch 67b. The opening of switch 67a deenergizes coil CMR and the closing of switch 67b energizes coil R5. The excitation of coil R5 closes contact C5 completing a circuit from point 89 along line 90 through contact C5 to line 91 thus energizing coil PMF. The excitation of coil PMF opens normally closed contacts PMF1 preventing excitation of coil PMR and also closing contacts PMF5 (as shown in Fig. 7) which causes the platform motor 35 to move the platform 24 from its printing position to its unloading position. The control circuit remains in this state until the platform reaches its unloading position and mechanically opens limit switch 62a and closes limit switch 62b. The opening of switch 62a deenergizes coil R4, thus opening contacts C4 and preventing excitation of coils SMR, CMR, and R5. Th loss of holding current on coil R5 opens contact C5 terminating holding current to coil PMF and thus terminating operation of platform motor 35. The control

circuit is now in a stable state and has completed its second cycle. As will be apparent from the foregoing description, the stencil 9 is in its upper position, the canopy 42 is in its extended position and the platform 24 is at its unloading position.

In the third cycle of operation of the control circuitry it is necessary only to move the platform from its unloading position in unloading zone C to its loading position in loading zone A. Depression of start button 75 energizes coil R1 thus closing contact C1b. The simultaneous closure of contacts C1a and C1c, also effected by depression of button 75, will not energize any of the other relay coils since limit switch 60a is open and 60b is closed due to the stencil's being in its upper position, and limit switch 62a is open, and 62b is closed due to the platform's being in its unloading position. Depression of start button 75 also energizes coil R6 through limit switch 65 which is closed as a result of the stencil's being in its upper position. Excitation of coil R6 closes contacts C6c. The closure of contact C1b completes a circuit through contacts C6c through switches 60b and 62b along lines 105 and 106 to coil PMR. The excitation of coil PMR closes contacts PMR5 (shown in Fig. 7) causing platform motor 35 to begin retracting the platform from its unloading position to its loading position. The excitation of coil PMR also opens normally closed contacts PMR1 preventing excitation of coil PMF. Furthermore excitation of coil PMR closes contacts PMR2 thus completing a circuit between point 107 and line 106. The closure of contacts PMR2 will provide a circuit for the holding current on coil PMR when limit switch 62b is opened by the platform's moving from its unloading position towards its loading position. The control circuitry will remain in this state until the platform arrives at its loading position and mechanically opens switch 60b and terminates holding current to coil PMR. This completes the third cycle of the control circuitry and the printing apparatus is now in the same state as was described at the beginning of the first cycle.

While this invention has been described in detail with particular reference to preferred embodiments thereof, it will be understood that variations and modifications can be effected within the spirit and scope of the invention as described hereinbefore and as defined in the appended claims.

Claims

1. A process for printing pile fabrics, wherein a stencil (9) defining a pattern is placed on said fabric and print paste is applied to said fabric, characterised in that the step of placing a stencil on said fabric includes the steps of defining pattern areas of said fabric by extending divider walls (20) generally perpendicularly to the base of said pile fabric and separating the pile of said pile fabric, and spraying said print paste within a pattern area.

2. A process, as claimed in claim 1, characterised in that said print paste is sprayed on said pile fabric within said pattern areas while maintaining the outlet (54) of the spraying apparatus (53) within a given pattern area and inwardly of the outermost edge (55) of said divider walls (20).

3. A process, as claimed in claim 2, characterised in that said spraying apparatus (53) is moved about said pattern area by hand to apply print paste throughout said pattern area.

4. A process, as claimed in claim 3, and further characterised by the steps of lifting said stencil (9) from said pile fabric after the step of applying print paste, and placing a canopy (42) between said stencil (9) and said pile fabric to shield said pile fabric from drippings of print paste from said stencil.

5. A process, as claimed in claim 4, further characterised by the steps of moving said pile fabric away from said stencil (9) and placing a second pile fabric adjacent to said stencil while said canopy (42) is in place, removing said canopy, and placing said stencil on said second pile fabric.

6. Apparatus for printing pile fabrics, including a stencil (9) for defining a pattern on said pile fabric and means for applying print paste to said pile fabric, characterised by a frame (10), at least one divider wall (20) supported within the confines of said frame (10), said divider wall (20) and said frame (10) defining a pattern, said divider wall (20) comprising a substantially flat wall disposable generally perpendicularly to said pile fabric (23).

7. Apparatus, as claimed in claim 6, and further characterised by a first plurality of wires (19) extending across said frame (10) in a first direction, a second plurality of wires (19) extending across said frame (10) in a second direction which is angularly related to said first direction, said divider wall (20) being carried by said first and second plurality of wires (19).

8. Apparatus, as claimed in claim 7, characterised by a plurality of divider walls (20) connected to provide at least one stencil element (18), said stencil element (18) being carried by said first and second plurality of wires (19).

9. Apparatus, as claimed in claim 8, characterised by a plurality of said stencil elements (18) within said frame (10), all of said plurality of stencil elements (18) being carried by said first and second plurality of wires (19), and means (38) for raising and lowering said frame (10).

10. Apparatus, as claimed in claim 9, and further characterised by a platform (24) for receiving a pile fabric (23), a rack (26) for selectively positioning said platform (24) beneath said stencil (9), and a canopy (42) selectively extendable beneath said stencil (9), between said platform (24) and said stencil (9).

11. Apparatus, as claimed in claim 10, and further characterised by a fly-bridge (56) over said stencil (9), said fly-bridge (56) being movable with respect to said stencil (9) and adapted to receive operators of the printing apparatus.

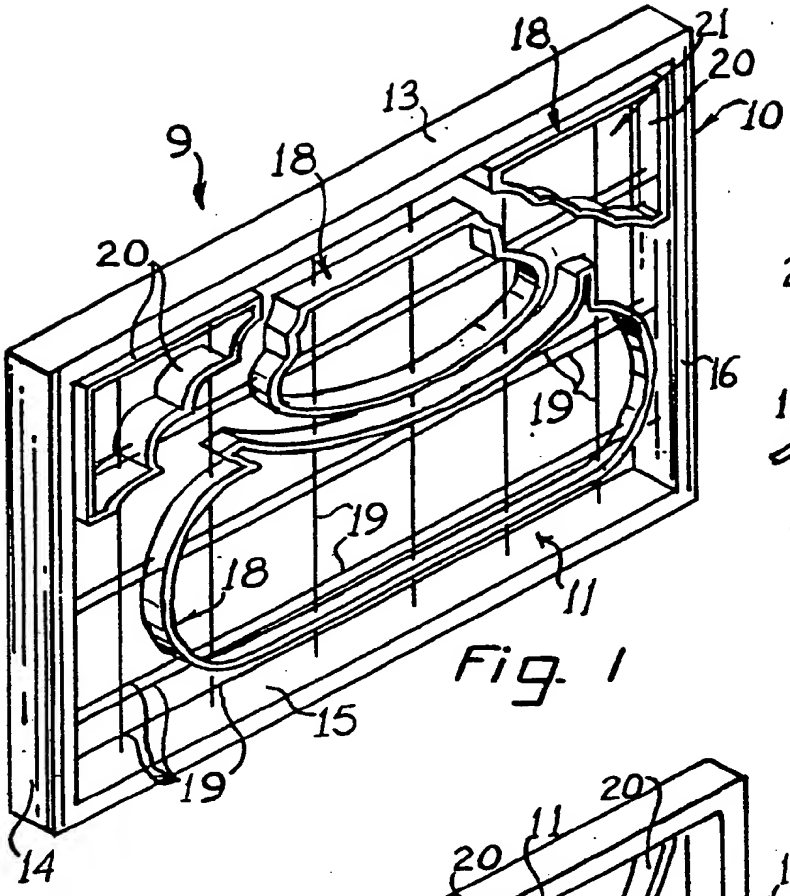


Fig. 1

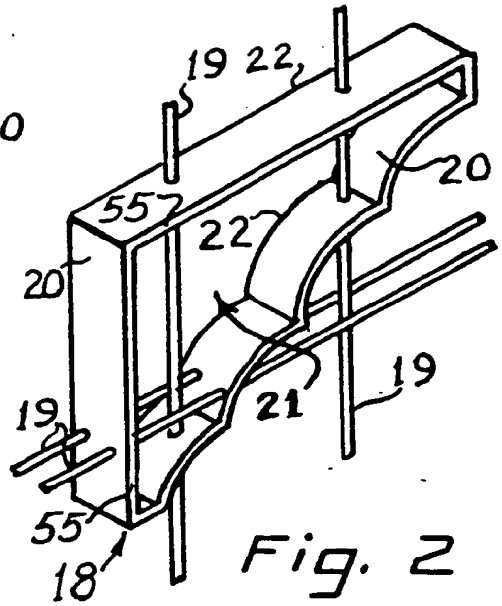


Fig. 2

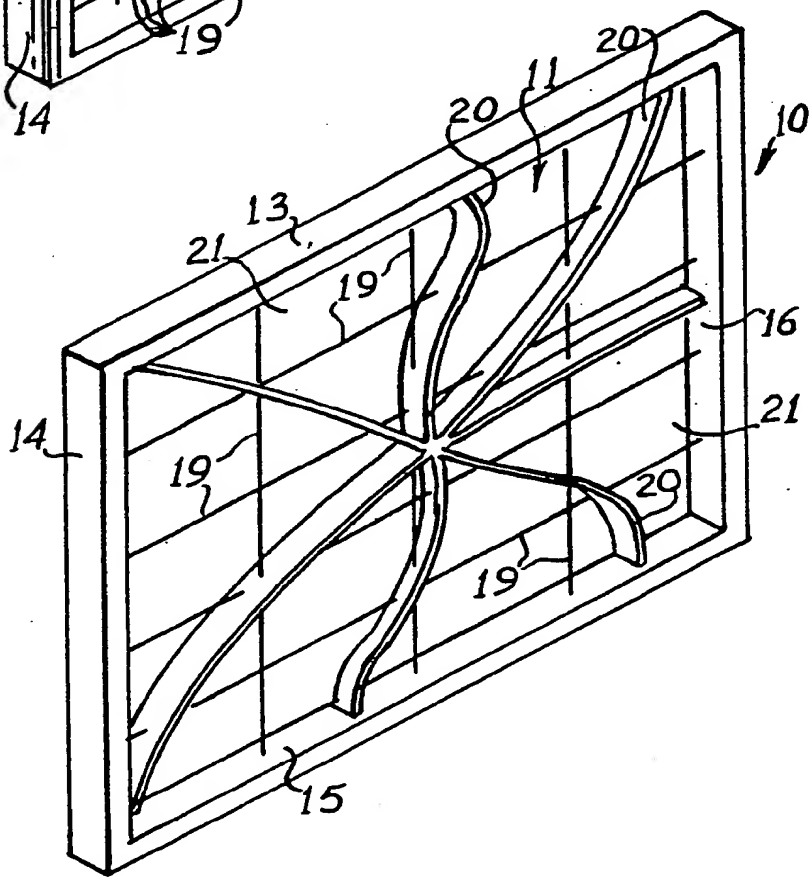


Fig. 3

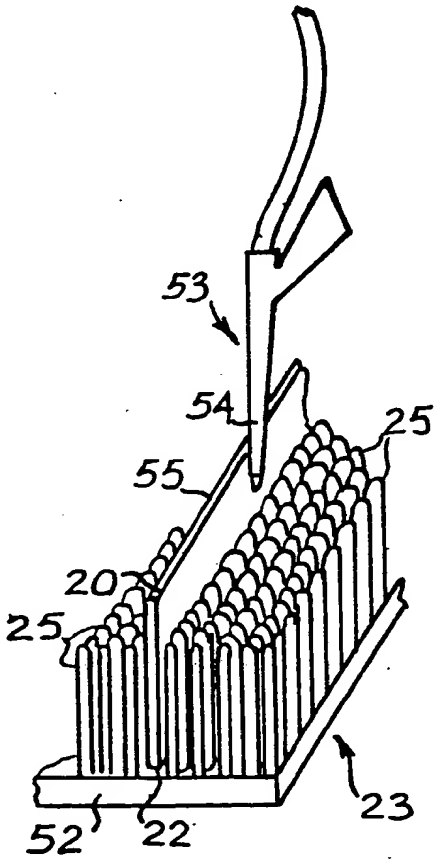


Fig. 5

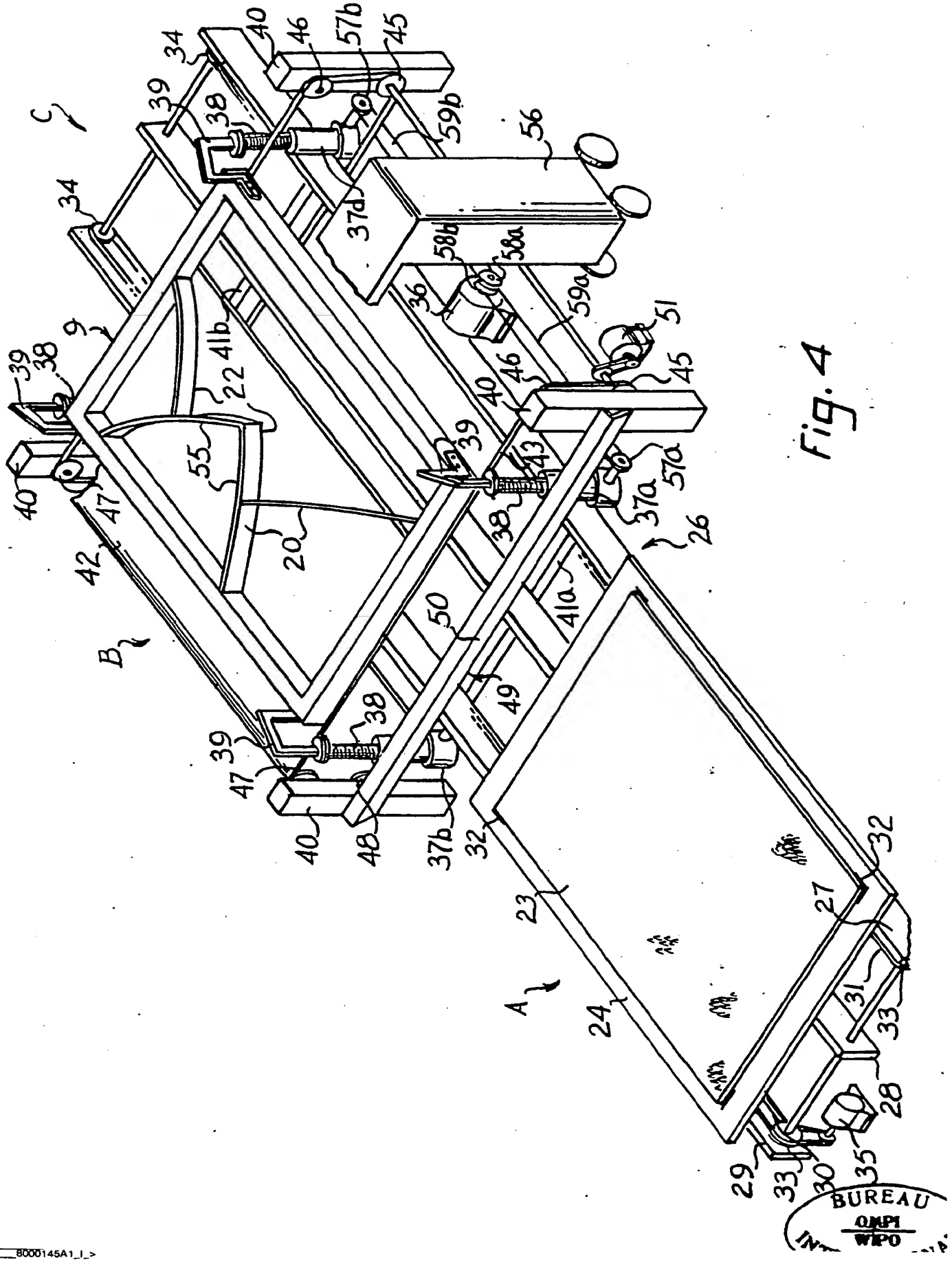


Fig. 4

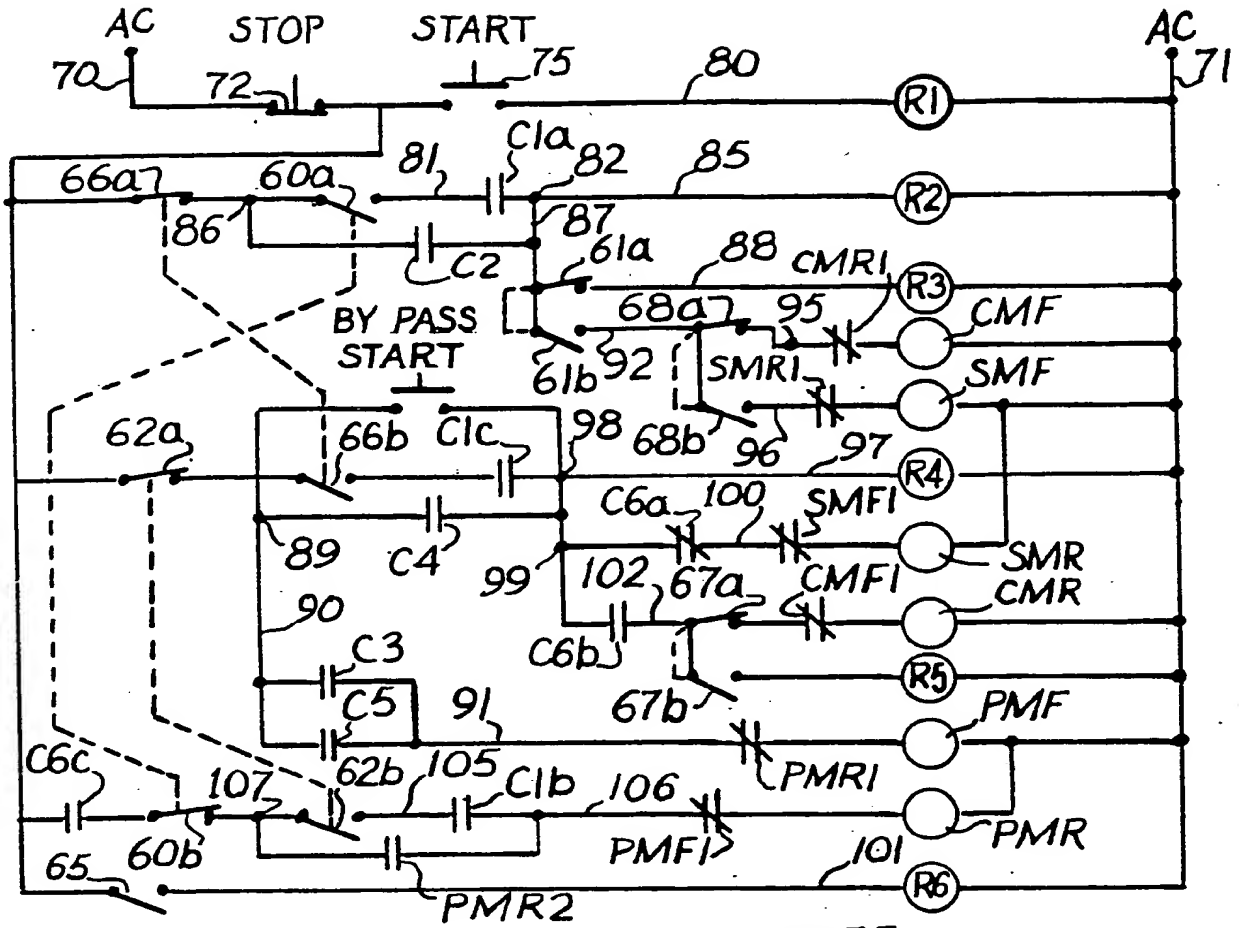


Fig. 6

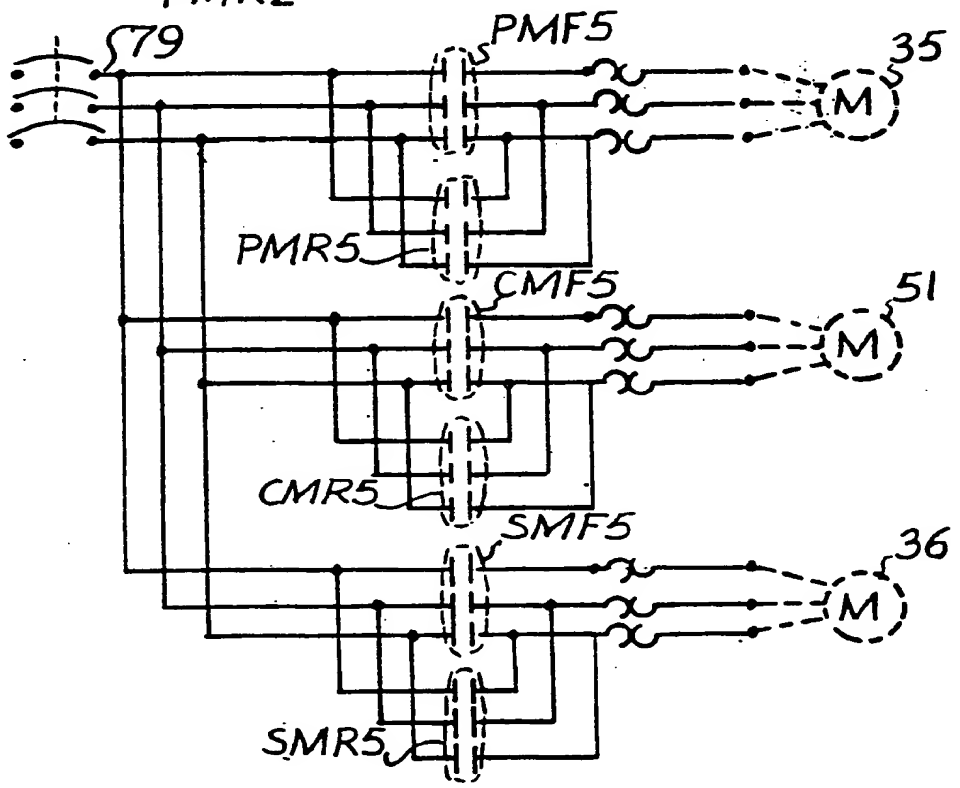


Fig. 7

INTERNATIONAL SEARCH REPORT

WO 80/00145

International Application No PCT/US79/00442

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl. B41M1/12, B41L13/02, B41F 15/04

U.S. Cl. 101/129,115

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
US	101/115,127,129; 239/104,120,121,122; 401/15

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
X	US,A, 3,292,532, Published 20 December 1966, columns 1,2,7,8,10, Berk	1-11
A	US,A, 234,492, Published 16 November 1880, Ream	7-11
A	US,A, 371,969, Published 25 October 1887, Prewitt	7-11
A	US,A, 737945, Published 01 September 1903, Lundeberg	6-11
A	US,A, 754,581, Published 15 March 1904, Magnus	6-11
A	US,A, 1,022,956, Published 09 April 1912, Lengerke	4,5,10,11
A	US,A, 1,229,779, Published 12 June 1917 Olson	1-11
A	US,A, 1,328,368, Published 20 January 1920 Cotoli	2-5

(Continued on Supplemental Sheet 2)

* Special categories of cited documents: [15]

"A" document defining the general state of the art

"E" earlier document but published on or after the international filing date

"L" document cited for special reason other than those referred to in the other categories

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but on or after the priority date claimed

"T" later document published on or after the international filing date or priority date and not in conflict with the application, but cited to understand the principle or theory underlying the invention

"X" document of particular relevance

IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
18 September 1979	05 OCT 1979
International Searching Authority [1]	**Signature of Authorized Officer [20]**
ISA/US	Clyde Coughenour

Form PCT/ISA/210 (second sheet) (October 1977)

FURTHER INF RMATI N CONTINUED FR M THE SEC ND SHEET

III		
A	US,A, 1,538,951, Published 26 May 1925, Pringle	2-5
A	US,A, 2,547,223, Published 03 April 1951, Lombardo	4,5,10,11
A	US,A, 3,654,658, Published 11 April 1972, Kovacs	4,5,10,11
A	DE, A, 19,060, Published 12 August 1882, Werner	1-11
A	GB,A, 815,704, Published 01 July 1959, Smith	1-11

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE [10]

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers _____, because they relate to subject matter [12] not required to be searched by this Authority, namely:

2. ☐ Claim numbers _____, because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out [13], specifically:

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING [11]

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

Remark on Protest

☐ The additional search fees were accompanied by applicant's protest.

☐ No protest accompanied the payment of additional search fees.